Remarks

The Office Action mailed November 28, 2007, and made final, has been carefully reviewed and the foregoing amendment has been made in consequence thereof.

Claims 1-20 are now pending in this application. Claims 1-20 stand rejected.

The rejection of Claims 1, 2, 9-13, 17, and 18 under 35 U.S.C. § 103(a) as being unpatentable over U.S. Pat. No. 6,628,743 to Drummond (hereinafter referred to as "Drummond") in view of U.S. Pat. No. 5,421,331 to Devito (hereinafter referred to as "Devito") is respectfully traversed.

Drummond describes a computed tomography imaging system (100) that includes an X-ray source (120) and a detector array (140) that are operably coupled to a computer (260). A process (300) is performed using the imaging system (100). The process (300) includes acquiring (305) a first volume of cardiac data using a first scan. The first volume of cardiac data is processed (310) to generate a first cardiac image set (160). More specifically, the first volume of data is processed (310) by performing reconstruction and visualization using known image reconstruction algorithms. Known visualization algorithms include multiplanar volume reformat (MPVR), Maximum Intensity Projection (MIP), 3D surface rendering or volume rendering (VR), and immersible viewing (i.e., viewing from the inside).

The process (300) in Drummond also includes acquiring (315) a second volume of cardiac data subsequent to the first volume of cardiac data. The second volume of cardiac data is processed (320) to generate a second cardiac image set (170) by performing reconstruction and visualization. The first image set (160) and the second image set (170) are reconstructed and visualized (325) using known software. A user determines (330), from the first volume of cardiac data, which anatomical region of interest, such as the coronary artery, the left ventricle, and the myocardial muscle, is to be used for subsequent analysis and post-processing. During post-processing, a series of short-axis reformatted images and volume-rendered 3D images of the heart are created (430). A degree of perfusion in the anatomical region is visualized by comparing regions of high and low contrast-enhancement. Other post-

processing may include displaying (460) an isometric view of the heart with long axis section planes (610) and short section planes that are perpendicular to the long axis section planes (610). As an alternative to the user determining (330) a region of interest, the image sets (160, 170) are analyzed (370) to determine a degree of myocardial perfusion by using an enhancement detection algorithm to differentiate enhanced regions of a myocardium from other regions of the heart, using an edge detection algorithm to identify contours of inner (600) and outer (602) walls of the myocardium, and using a segmentation algorithm to separate the myocardial musculature. The analyzed image sets (160, 170) of the myocardium may be displayed in a planar short axis reformat view.

Notably, Drummond does not describe nor suggest selecting a layout for displaying views of the heart and automatically producing a set of images of a portion of the heart, wherein an orientation, with respect to a calculated long axis, of each of the produced images is automatically determined based on a cardiac 3D dataset of the portion of the heart and the selected layout. Rather, Drummond describes a post-processing algorithm that determines an image of a phase representative of end diastole and/or end systole. Applicants submit that merely describing a post-processing algorithm that determines an image of a phase of the cardiac cycle is not descriptive nor suggestive of selecting a layout for displaying views of the heart and automatically producing a set of images of a portion of the heart, wherein an orientation, with respect to a calculated long axis, of each of the produced images is automatically determined based on a cardiac 3D dataset of the portion of the heart and the selected layout.

Devito describes an apparatus for automatically identifying a long axis (12) of a left ventricle from SPECT data acquired during a nuclear medicine study of a patient's heart (4). The apparatus includes a computer (8) for automatically reconstructing and automatically selecting, from the SPECT data, a single slice of the left ventricle, wherein the single slice is assumed to be a representative transverse slice of the left ventricle. The computer (8) automatically defines a reorientation axis that passes through a center of the single slice and is intersected by the long axis (12) of the left ventricle. The computer (8) automatically reconstructs, from the SPECT data and along the reorientation axis, a sagittal slice of the left

ventricle. The computer (8) also automatically defines an axis which passes through a center of the sagittal slice. Such a determined axis is the long axis (12) of the left ventricle. The reorientation axis and the axis are defined using local maxima (42) and local minima in the representative transverse slice. Views of the heart (4) that are oblique a body axis (2A) are produced and displayed by slicing reconstructed SPECT data perpendicular to the long axis (12). Notably, Devito does not describe nor suggest selecting a layout for displaying views of the heart and automatically producing a set of images of a portion of the heart, wherein an orientation, with respect to a calculated long axis, of each of the produced images is automatically determined based on a cardiac 3D dataset of the portion of the heart and the selected layout.

Claim 1 recites a method for generating views of a heart along anatomically useful planes, said method comprising "selecting a layout for displaying the views . . . selecting an imaging exam configured to produce a 3D dataset representing at least one portion of the heart during at least one phase . . . generating, by a processor, the cardiac 3D dataset . . . calculating, from the cardiac 3D dataset, at least one of a short axis and a long axis without user intervention . . . generating, by a processor, a volume of a ventricle of the heart based on the imaging exam selected, wherein said generating the volume comprises creating the volume by region growing . . . automatically producing a set of images of the at least one portion of the heart, wherein an orientation, with respect to the long axis, of each of the produced images is automatically determined based on the cardiac 3D dataset and the selected layout . . . and diagnosing the heart by analyzing the volume and the produced set of images."

Neither Drummond nor Devito, considered alone or in combination, describes or suggests a method as is recited in Claim 1. More specifically, neither Drummond nor Devito, considered alone or in combination, describes or suggests a method including selecting a layout for displaying views of the heart and automatically producing a set of images of a portion of the heart, wherein an orientation, with respect to a calculated long axis, of each of the produced images is automatically determined based on a cardiac 3D dataset of the portion of the heart and the selected layout. Rather, Drummond describes that images may be

displayed as short-axis reformatted image, as an isometric view of the heart with long axis section planes, or as a view of the heart along short section planes that are perpendicular to the long axis section planes, and Devito describes producing and displaying views of a heart that are oblique to a body axis by slicing reconstructed SPECT data perpendicular to a determined long axis.

Accordingly, Applicants submit that Claim 1 is patentable over Drummond in view of Devito.

Claims 2 and 9-11 depend from independent Claim 1. When the recitations of Claims 2 and 9-11 are considered in combination with the recitations of Claim 1, Applicants submit that Claims 2 and 9-11 likewise are patentable over Drummond in view of Devito.

Claim 12 recites a computer readable medium encoded with a program executable by a computer for generating views of a heart along anatomically useful planes, said program configured to instruct the computer to "receive a selection representing a layout for displaying the views . . . receive a selection representing an imaging exam configured to produce a 3D dataset representing at least one portion of the heart during at least one phase . . . automatically receive the cardiac 3D dataset representing the at least one portion of the heart . . . calculate, from the cardiac 3D dataset, at least one of a short axis and a long axis without user intervention . . . generate a volume of a ventricle of the heart based on the imaging exam selected, wherein to generate the volume, said program configured to instruct the computer to create the volume by region growing . . . automatically produce a set of images of the at least one portion of the heart, wherein an orientation, with respect to the long axis, of each of the produced images is automatically determined based on the cardiac 3D dataset and the selected layout . . . and diagnose the heart by analyzing the volume and the produced set of images."

Neither Drummond nor Devito, considered alone or in combination, describes or suggests a computer readable medium as is recited in Claim 12. More specifically, neither Drummond nor Devito, considered alone or in combination, describes or suggests a computer readable medium encoded with a program that is configured to instruct a computer to receive

a selection representing a layout for displaying views of a heart and automatically produce a set of images of a portion of the heart, wherein an orientation, with respect to a calculated long axis, of each of the produced images is automatically determined based on a cardiac 3D dataset of the portion of the heart and the selected layout. Rather, Drummond describes that images may be displayed as short-axis reformatted image, as an isometric view of the heart with long axis section planes, or as a view of the heart along short section planes that are perpendicular to the long axis section planes, and Devito describes producing and displaying views of a heart that are oblique to a body axis by slicing reconstructed SPECT data perpendicular to a determined long axis.

Accordingly, Applicants submit that Claim 12 is patentable over Drummond in view of Devito.

Claim 13 depends from independent Claim 12. When the recitations of Claim 13 are considered in combination with the recitations of Claim 12, Applicants submit that Claim 13 likewise is patentable over Drummond in view of Devito.

Claim 17 recites a medical imaging apparatus for generating views of a heart along anatomically useful planes, said medical imaging system apparatus comprising "an imaging system comprising . . . a detector array . . . at least one radiation source . . . and a computer coupled to said detector array . . . and a workstation coupled to said computer, said workstation configured to . . . receive a selection representing a layout for displaying the views . . . receive a selection representing an imaging exam configured to produce a 3D dataset representing at least one portion of the heart during at least one phase . . . automatically receive the cardiac 3D dataset representing the at least one portion of the heart . . . calculate at least one of a short axis and a long axis without user intervention . . . generate a volume of a ventricle of the heart based on the imaging exam selected, wherein to generate the volume, said workstation configured to create the volume by region growing . . . and automatically produce a set of images of the at least one portion of the heart, wherein an orientation, with respect to the long axis, of each of the produced images is automatically determined based on the cardiac 3D dataset and the selected layout."

Neither Drummond nor Devito, considered alone or in combination, describes or suggests a medical imaging apparatus as is recited in Claim 17. More specifically, neither Drummond nor Devito, considered alone or in combination, describes or suggests a medical imaging apparatus including a workstation configured to receive a selection representing a layout for displaying views of a heart and automatically produce a set of images of a portion of the heart, wherein an orientation, with respect to a calculated long axis, of each of the produced images is automatically determined based on a cardiac 3D dataset of the portion of the heart and the selected layout. Rather, Drummond describes that images may be displayed as short-axis reformatted image, as an isometric view of the heart with long axis section planes, or as a view of the heart along short section planes that are perpendicular to the long axis section planes, and Devito describes producing and displaying views of a heart that are oblique to a body axis by slicing reconstructed SPECT data perpendicular to a determined long axis.

Accordingly, Applicants submit that Claim 17 is patentable over Drummond in view of Devito.

Claim 18 depends from independent Claim 17. When the recitations of Claim 18 are considered in combination with the recitations of Claim 17, Applicants submit that Claim 18 likewise is patentable over Drummond in view of Devito.

For at least the reasons set forth above, Applicants respectfully request that the Section 103 rejection of Claims 1, 2, 9-13, 17, and 18 be withdrawn.

The rejection of Claim 3 under 35 U.S.C. § 103(a) as being unpatentable over Drummond in view of Devito and further in view of U.S. Pub. No. 2003/0153823 to Geiser (hereinafter referred to as "Geiser") is respectfully traversed.

Drummond and Devito are described above. Geiser describes a method for automatically analyzing a long-axis image of a heart. The long axis image is an image of the heart that shows structures in a plane parallel to a longitudinal axis extending from an apex or tip of the heart to a base, which can include the aorta and posterior portions of the left and right atrium. The method includes generating an image frame of a myocardium (14),

interventricular septum (30), and mitral valve annulus (36) of the heart, and determining an approximate position of the interventricular septum (30) from a diagnostic image. The position is determined by passing a filter (42) through the image to determine a maximum mean pixel intensity, wherein the maximum is a first approximate position of the interventricular septum (30). A second approximate position of the interventricular septum (30) is defined with a series of straight line filters (46), and a best fit line (50) through the second approximate position from an upper portion of the series of straight line filters (46) is obtained.

The method in Geiser also includes determining an approximate position of a medial border of the mitral valve annulus (36) by passing a right-angle filter (52) down the determined best fit line (50) until a maximum mean pixel intensity is determined, wherein the maximum is indicative of the approximate position of the mitral valve annulus (36). A registration point (60) is determined as the point at which the best fit line (50) intersects the approximate position of the mitral valve annulus (36), one or more regions of the myocardium (14) are located in relation to the registration point (60), and the mean pixel intensity in each of the regions of the myocardium (14) is calculated, wherein the mean pixel intensity provides an analysis of the long axis image of the heart. Notably, Geiser does not describe nor suggest selecting a layout for displaying views of the heart and automatically producing a set of images of a portion of the heart, wherein an orientation, with respect to a calculated long axis, of each of the produced images is automatically determined based on a cardiac 3D dataset of the portion of the heart and the selected layout.

Claim 3 depends from Claim 1, which is recited above.

None of Drummond, Devito, and Geiser, considered alone or in combination, describes or suggests a method as is recited in Claim 1. More specifically, none of Drummond, Devito, and Geiser, considered alone or in combination, describes or suggests a method including selecting a layout for displaying views of the heart and automatically producing a set of images of a portion of the heart, wherein an orientation, with respect to a calculated long axis, of each of the produced images is automatically determined based on a cardiac 3D dataset of the portion of the heart and the selected layout. Rather, Drummond

describes that images may be displayed as short-axis reformatted image, as an isometric view of the heart with long axis section planes, or as a view of the heart along short section planes that are perpendicular to the long axis section planes, Devito describes producing and displaying views of a heart that are oblique to a body axis by slicing reconstructed SPECT data perpendicular to a determined long axis, and Geiser that a long axis image is an image of the heart that shows structures in a plane parallel to a longitudinal axis extending from an apex or tip of the heart to a base, which can include the aorta and posterior portions of the left and right atrium.

Accordingly, Applicants submit that Claim 1 is patentable over Drummond in view of Devito and further in view of Geiser.

Claim 3 depends from independent Claim 1. When the recitations of Claim 3 are considered in combination with the recitations of Claim 1, Applicants submit that Claim 3 likewise is patentable over Drummond in view of Devito and further in view of Geiser.

For at least the reasons set forth above, Applicants respectfully request that the Section 103 rejection of Claim 3 be withdrawn.

The rejection of Claims 4-8, 14-16, 19, and 20 under 35 U.S.C. § 103(a) as being unpatentable over Drummond in view of Devito and further in view of U.S. Pat. No. 6,217,520 to He (hereinafter referred to as "He") is respectfully traversed.

Drummond and Devito are described above. He describes a method for calculating a volume of an extracted object of interest in a diagnostic medical ultrasound image. The method includes extracting an object of interest from a diagnostic medical ultrasound image, calculating a center of mass of the extracted object of interest, calculating an axis of least second momenta through the center of mass of the extracted object of interest, and calculating the rotational volume around the axis of least second momenta. The axis of least second momenta can be assumed to be a long axis. The diagnostic medical ultrasound image may be acquired by setting a first acquisition trigger at the end of systole (ES) and a second acquisition trigger at the end of diastole (ED). Notably, He does not describe nor suggest selecting a layout for displaying views of the heart and automatically producing a set of

images of a portion of the heart, wherein an orientation, with respect to a calculated long axis, of each of the produced images is automatically determined based on a cardiac 3D dataset of the portion of the heart and the selected layout.

Claims 4-8 depend from Claim 1, which is recited above.

None of Drummond, Devito, and He, considered alone or in combination, describes or suggests a method as is recited in Claim 1. More specifically, none of Drummond, Devito, and He, considered alone or in combination, describes or suggests a method including selecting a layout for displaying views of the heart and automatically producing a set of images of a portion of the heart, wherein an orientation, with respect to a calculated long axis, of each of the produced images is automatically determined based on a cardiac 3D dataset of the portion of the heart and the selected layout. Rather, Drummond that images may be displayed as short-axis reformatted image, as an isometric view of the heart with long axis section planes, or as a view of the heart along short section planes that are perpendicular to the long axis section planes, Devito describes producing and displaying views of a heart that are oblique to a body axis by slicing reconstructed SPECT data perpendicular to a determined long axis, and He describes calculating a center of mass of an extracted object of interest and calculating an axis of least second momenta through the center of mass of the extracted object.

Accordingly, Applicants submit that Claim 1 is patentable over Drummond in view of Devito and further in view of He.

Claims 4-8 depend from independent Claim 1. When the recitations of Claims 4-8 are considered in combination with the recitations of Claim 1, Applicants submit that Claims 4-8 likewise are patentable over Drummond in view of Devito and further in view of He.

Claims 14-16 depend from Claim 12, which is recited above.

None of Drummond, Devito, and He, considered alone or in combination, describes or suggests a computer readable medium as is recited in Claim 12. More specifically, none of Drummond, Devito, and He, considered alone or in combination, describes or suggests a

computer readable medium encoded with a program that is configured to instruct a computer to receive a selection representing a layout for displaying views of a heart and automatically produce a set of images of a portion of the heart, wherein an orientation, with respect to a calculated long axis, of each of the produced images is automatically determined based on a cardiac 3D dataset of the portion of the heart and the selected layout. Rather, Drummond describes that images may be displayed as short-axis reformatted image, as an isometric view of the heart with long axis section planes, or as a view of the heart along short section planes that are perpendicular to the long axis section planes, Devito describes producing and displaying views of a heart that are oblique to a body axis by slicing reconstructed SPECT data perpendicular to a determined long axis, and He describes calculating a center of mass of an extracted object of interest and calculating an axis of least second momenta through the center of mass of the extracted object.

Accordingly, Applicants submit that Claim 12 is patentable over Drummond in view of Devito and further in view of He.

Claims 14-16 depend from independent Claim 12. When the recitations of Claims 14-16 are considered in combination with the recitations of Claim 12, Applicants submit that Claims 14-16 likewise are patentable over Drummond in view of Devito and further in view of He.

Claims 19 and 20 depend from Claim 17, which is recited above.

None of Drummond, Devito, and He, considered alone or in combination, describes or suggests a medical imaging apparatus as is recited in Claim 17. More specifically, none of Drummond, Devito, and He, considered alone or in combination, describes or suggests a medical imaging apparatus including a workstation configured to receive a selection representing a layout for displaying views of a heart and automatically produce a set of images of a portion of the heart, wherein an orientation, with respect to a calculated long axis, of each of the produced images is automatically determined based on a cardiac 3D dataset of the portion of the heart and the selected layout. Rather, Drummond describes that images may be displayed as short-axis reformatted image, as an isometric view of the heart with long

axis section planes, or as a view of the heart along short section planes that are perpendicular to the long axis section planes, Devito describes producing and displaying views of a heart that are oblique to a body axis by slicing reconstructed SPECT data perpendicular to a determined long axis, and He describes calculating a center of mass of an extracted object of interest and calculating an axis of least second momenta through the center of mass of the extracted object.

Accordingly, Applicants submit that Claim 17 is patentable over Drummond in view of Devito and further in view of He.

Claims 19 and 20 depend from independent Claim 17. When the recitations of Claims 19 and 20 are considered in combination with the recitations of Claim 17, Applicants submit that Claims 19 and 20 likewise are patentable over Drummond in view of Devito and further in view of He.

For at least the reasons set forth above, Applicant respectfully request that the Section 103 rejection of Claims 4-8, 14-16, 19, and 20 be withdrawn.

In view of the foregoing amendment and remarks, all the claims now active in this application are believed to be in condition for allowance. Reconsideration and favorable action is respectfully solicited.

Respectfully submitted,

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